The difference on weight bearing asymmetry in the frontal plane by treating the upper cervical spine with HVLA- Thrust or Strain/Counterstrain

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by ***Karl-Heinz Bauer***

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TRANSLATED BY *JENNY PARKINSON*

Eidesstattliche Erklärung

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ABSTRACT

Study Design: A matched, pre- and post-test experimental design with three measurements

Problem Definition: Visual, vestibular and sensorimotor afferences are needed for the regulation of balance. A functional disorder of the cervical spine can lead to an impaired vestibulo-spinal reaction ability. It is observed, that these subjects lose their ability to distribute weight evenly in the frontal plane in upright, still bipedal standing. This weight bearing asymmetry (WBA) is considered pathogenic if the weight bearing difference exceeds 4 kg under the feet. It was shown that the postural stability decreases in the quiet upright standing if the WBA increases.

Research Question: Osteopathic treatment for these functional cervical disorders aims at the increase of postural stability. The question is, how effective are the used techniques.

Hypothesis: The Strain/Counter-strain technique and the HVLA-thrust technique, applied to the upper cervical spine with a functional disorder, produce the same effect for the WBA.

Relevance for the Patients: Some patients had a bad experience with a HVLA- technique; they are often afraid and have a high muscle tone during treatment.

Relevance for Osteopathy: Is it necessary to take the risk of complications from an HVLA-thrust technique if there is an alternative.

Methodology: The subject group consisted of 60 patients, only female. The most important inclusion criterion was that the subject had a WBA of more than 4 kg in the two-scale test. The age of the subjects ranged from 21 to 42 years. The subjects were devided into a control group (n=20) and two intervention groups (HVLA-technique and Strain/Counterstrain). A two-scale test was used to measure the influence of upper cervical spine treatment on the WBA pre- and post-treatment and two weeks later. The two-scale test measures the ability of the subject to distribute the weight evenly on both feet.

Results: Parametrical tests (variance analysis) and non-parametrical tests (Kruskal-Wallis-Test) verified whether the treatment as the independent variable has a significant effect on the WBA as the dependent variable. In the control group there was no significant change in the two-scale test ($p>0.05$). After the treatment (2^{nd} measurement) the intervention groups differed significantly from the control group ($p=0.0001$). This difference remains after 2 weeks (3^{rd} measurement). We can conclude that the treatment with the Strain/Counterstrain technique and the HVLA-Thrust technique bring sustainable results. However the HVLA-Thrust technique even shows another significant improvement in the measurement repetition between the second and third measurement. It can be seen as the more effective treatment procedure. The Strain/Counterstrain technique and the HVLA-Thrust technique don’t have the same effect.

Conclusions: This leads to the conclusion that the treatment of the upper cervical spine with strain/counterstrain and HVLA-thrust technique both bring good results. Even though the HVLA –thrust technique has the stronger effect, the strain/counterstrain technique can be an alternative if one wants to reduce the risk for the patient.

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1 INTRODUCTION

During the inspection in an osteopathic diagnosis, the osteopath looks for asymmetries in the standing patient. Changes, and especially alterations from the optical midline (frontal plane and sagittal plane) are noticed. They will be seen as an indicator for a positive influence on the patient after treatment (Richard, 1994; Dummer, 1999; Parsons & Marcier, 2006; Mitchell & Mitchell, 2004).

In many treatment concepts with a somatic emphasis, the treatment of the upper cervical spine is attributed an important role in the regulation of the spine and the posture (Hartmann, 1997; Richard, 1994; Dummer, 1999; Mitchell & Mitchell, 2004). An influence on the regulation of somato-visceral reflex cycles is also postulated (Richard, 1994; Mitchell & Mitchell, 2004).

There is a contentious debate as to whether the benefit of upper cervical manipulation makes up for the risks of such a treatment (A. vertebralis injuries) (Schlingen & Graf-Baumann, 1997; Sturzenegger, 1994; Bayer, 1998; Szabela et al., 1997; Ringelstein, 1997; Peters et al., 1995; Beck, 2008, Cassidy et al., 2008; Thiel et al., 2007).

Complications in fact only come about very rarely (Klougart et al., 1996). In actual practice, however, patients are unsure, sometimes refusing any manipulation to the cervical spine or they have more defensive tension, which makes it more difficult to carry out the manipulations (Beck, 2004).

With this in mind, some osteopaths are looking for some non-manipulative techniques, such as the strain and counterstrain technique according to Jones. Checking through the literature, one unfortunately finds a shortage of studies on the effectiveness of the Strain/Counterstrain technique and thrust technique in comparison to Strain/Counterstrain (Bauer, 2004; Faulmüller, 2003).

Research question

Is there a difference between the effectiveness of a HVLA-thrust technique and the Strain/Counterstrain technique in the treatment of the cervical spine for the regulation of the body, under the influence of gravity in a standing position?

2. BACKGROUND

It is important for the understanding to know how works the regulation of balance in the standing position.

2.1 CONTROL OF BALANCE

Definition

The body does not stand completely still in a bipedal upright standing position. Instead it sways with small oscillating movements (postural sway) around the center of pressure. This means that the center of mass (CoM) of the body, which is the sum of all partial center of gravities, over a force pointing to the ground, has to be over the area formed by the feet. The center of the forces delivered onto the ground by the foot is defined as the center of pressure (CoP) (Klein & Sommerfeld, 2007).

Regulating models

When standing upright, the body is not in complete stillness. There are small oscillating movements in an anterior/posterior and latero/lateral direction – the postural sway. In the sagittal plain, these movements primarily take place around the ankle joint, in order to move the entire body (en bloc) forwards and backwards. During the postural control one mainly uses the ankle joint strategy for little demands mainly in the sagittal plane to keep the balance. The hip load/ unload-mechanism takes place in the frontal plane and is usually smaller than the sway in the sagittal plane (Klein &Sommerfeld, 2007).

Central integration

The centres of control require the following information to enable co-ordinated motion for upright standing and walking: What is the position of the head in relation to its space around him (gravity), the head to the body and the head/body to the surroundings? This comes from the labyrinth sensors, the optic system, the neck sensors and other somatosensory inputs (Zenner, 1998; Brokmeier, 1995; Kahle, 1991). These afferent inputs are integrated centrally, both in the brain stem and the cerebellum, and then act upon alpha or gamma neurons at various spinal levels (Nansel et al., 1993).

The most important areas peripherally that provide input are the cervical spine and the feet (Ghez, 1991; Mergner et al., 1991).

2.2 Weight-bearing asymmetry

One can observe, that subjects in the still upright bipedal standing position lose the capacity for symmetric weight bearing in the frontal plane. If this weight bearing asymmetry (WBA) exceeds a difference of 4 kg it is considered pathogenic. (Hülse & Hölzl, 2000; Lewit, 1997 and 1986).

This WBA has also been observed in healthy elderly people and has consequently been discussed as a result of the aging process (Blaszczyk et al., 2000; Marigold et al., 2006; Genthon &Rougier, 2005). Also in stroke patients this WBA has been observed (Marigold et al., 2006; Genthon et al., 2008). Blaszczyk et al. 2000 perceive the WBA as a compensation mechanism in order to enable the body to do a quicker compensatory safety step to prevent falling (Thelen et al., 1997).

The WBA described above and the postural sway are two different mechanisms that occur parallel to each other. However, the study of Anker et al. 2008 concludes, that the weight bearing asymmetry (WBA) and postural control are interrelated. The results show, that both components of postural control, the kinetic regulation and the asymmetry regulation, are increased, if the WBA has increased. It was observed, that the postural stability during the quiet upright standing is decreased if the WBA increases. This is the case in the frontal plane (hip load/ unload-mechanism) and also, in a lesser degree, for the postural stability in the sagittal plane (Anker et al., 2008; Blaszczyk et. al., 2000; Marigold et. al., 2006; Genthon & Rougier, 2005).

2.3 HVLA-Thrust Technique

Definition:

The high velocity low amplitude (HVLA) thrust technique is usually used to treat pain and dysfunction in osteopathic medicine. As the name suggests, it is a technique executed with the hands with an impulse of high velocity and low amplitude. This manipulation should release a joint cavitation, accompanied by a cracking sound (Gibbons & Tehan, 2004; Hartmann, 1997).

Risks:

After an impulse technique at the cervical spine there is the risk of an injury. The main sources are neuro-vascular damages and instabilities of the bony-ligamentous- apparatus. The estimated number of serious undesired side effects vary considerably. The given numbers range from 1 in 50 000 to 1 in 5 000 000 cases (Gibbons & Tehan, 2004; Rivett & Milburn, 1996). Considering the risks versus the gain, most authors agree, that with an exact patient selection and an experienced therapist the risk is justifiably low (Parenti, et al., 1999; Machado et al., 1999; Lee et al. 1995; Frisoni & Anzola, 1991).

Complications:

Non-reversable damages are death, cerebro-vascular incidents, compression of the spinal cord and cauda-syndrome. Fractures, Nerve root compressions, slipped discs and protrusions are catogorized as severe reversible damages. The transitory reactions of local pain, headaches, fatigue, paresthesia, dizziness, nausea and loss of consciousness are more common (Gibbons and Tehan, 2004). A study about side effects after a manipulation showed, that 55 % of all patients had experienced one of these unpleasant reactions at least once. However, these mild side effects usually disappear again within 24 hours (Senstad et. al., 1997).

Psychological Aspects

For the clinical question before doing a HVLA- technique, the patients can be devided into three possible reaction types. The first group of patients did not have any, or at least no negative, experience with a thrust technique. This „neutral patient“ can be described as non-judgmental and positively expectant. The second reaction type has either had a personal bad experience or has been influenced negatively by someone elses opinion. When treating these patients with a HVLA- technique, they are often afraid and have a high muscle tone; the treatment result might not be as good. The last group however, has had positive experiences in the past and is expecting an improvement to the current condition. A PET-Scan-Analysis, which was done with these patients, proved, that the treatment activated the dopamin system in the Area A10, leading to the release of endogenous opioids. The perceived treatment results of these patients are often better than the therapist had expected (Beck, 2008).

2.4 STRAIN/COUNTERSTRAIN-TECHNIQUE

Definition

Jones (1989) described for the first time how strain/counter-strain therapy was carried out. He emphasised the connection of many functional disorders with certain tender points. These points may also be located far away from the place where the problem is. They do not have to match the conventional anatomic conception, but with their characteristic tenderness they display clear relevance. The technique consists of determining the tender point ascribed to the somatic dysfunctions concerned and then to position the patient in such a way that the tender point stops hurting. The patient is held in that position for ninety seconds and then slowly brought back into the normal position (Jones, 1989).

The tenderpoints seem to correlate with the Ah Shi-points in acupuncture. These points are only temporarily present in connection with a joint dysfunction and can literally be called voluntary acupuncture points (Chaitow, 2003).

Physiological mechanisms

The physiological mechanism of the Jones technique is not understood. Among the various schools of therapy, there are different hypothesis for this principle and the precise localisation of the tender points.

The proprioceptive hypothesis assumed that the dysfunction is based on incorrect guiding of a movement and that it is maintained by spastic muscles (Bailey & Dick, 1992). If the body is guided back into a pain-free position via the lesion route and held there for ninety seconds, this can diminish the proprioreceptive feedback and the stimulation of the gamma neurons. The proprioreceptors readjust to this position, the spasm diminishes, and the normal patterns of joint movement are restored (Hartmann, 1997; Jones, 1989; McPartland et al., 1998; Woolbright, 1991).

The nociceptive hypothesis states another possible explanatory model. This postulates, that nociceptive protective reflex cycles, caused by traumatic influences, have induced the dysfunction (Van Buskirk, 1990; Chaitow, 2003).

In a study about the effect of counterstrain on stretch reflexes, Hoffmann reflexes, and clinical outcomes in subjects with plantar fasciitis, the clinical improvement is accompanied by mechanical, but not electrical, changes in the reflex responses of the calf muscles. The causative relation between the mechanical changes and the clinical responses remains to be explored (Wynne et al., 2006).

2.5 STUDY HYPOTHESIS

The aim of the study is to test the difference of treating the upper cervical spine with Strain/Counterstrain technique and the HVLA-thrust technique on weight bearing asymmetry.

Null hypothesis:

The null hypothesis states that Strain/Counterstrain technique and the HVLA-thrust technique applied on the upper cervical spine with a functional disorder does not produce the same effect for weight bearing asymmetry.

Hypothesis:

The experimental hypothesis states that Strain/Counter-strain technique and the HVLA-thrust technique applied on the upper cervical spine with a functional disorder does produce the same effect for weight bearing asymmetry.

3. METHODOLOGY

3.1 STUDY DESIGN

The study was based on a same subject, matched controlled, pre- and post-test design. Three groups were used; one control group and two intervention groups.

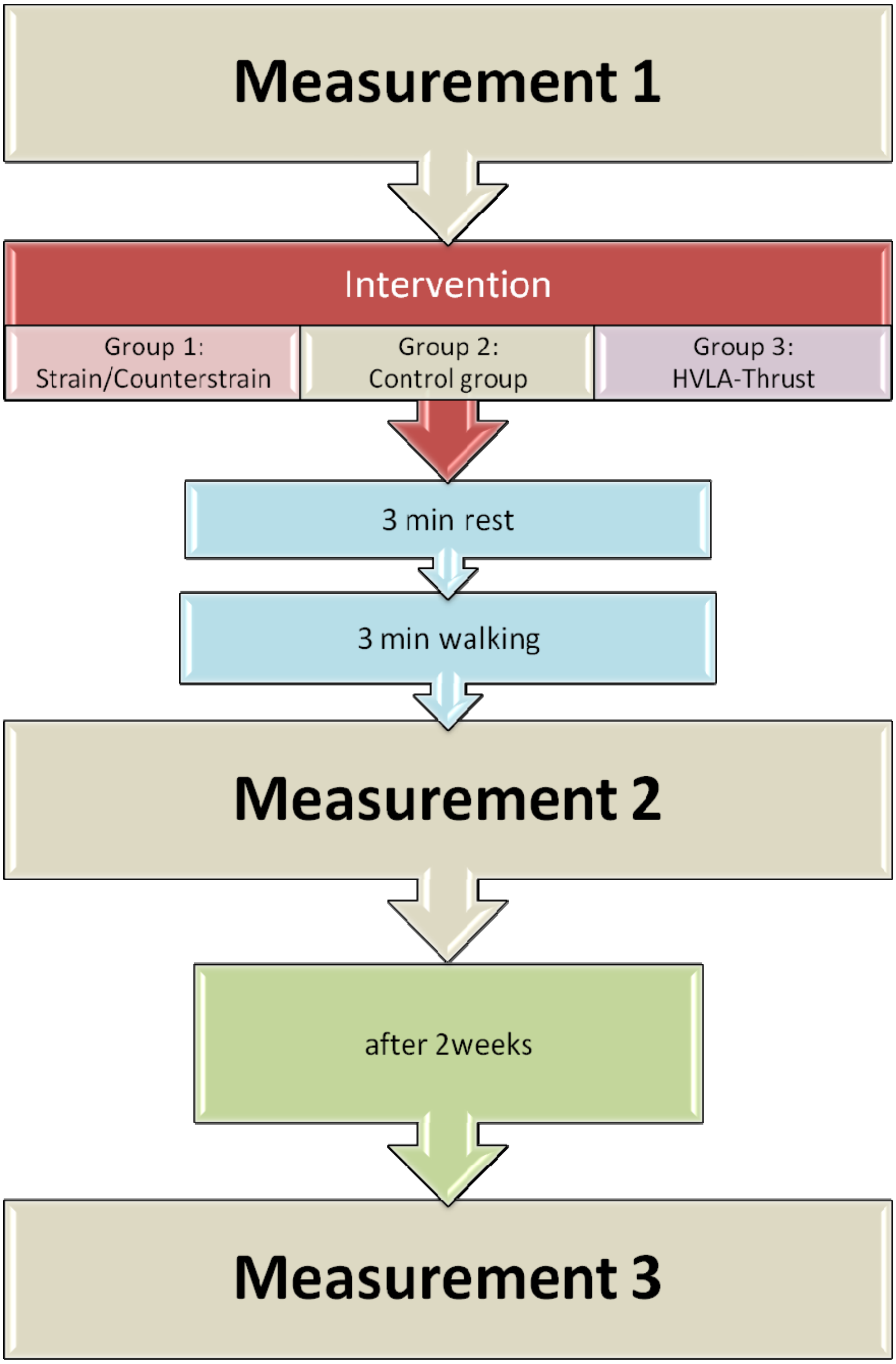
The first measurement (M1) was taken immediately before treatment, the second (M2) six minutes after treatment, and the third (M3) two weeks later without further treatment. Group 1 received a strain and counterstrain treatment of the upper cervical spine. Group 2 was treated with an osteopathic HVLA-technique also of the upper cervical spine. The group 3 was subjected to a sham manipulation. All treatments were taken between the first and second measurement.

Subjects were matched, allocated to each group and the dependent variable measured was the difference in the unequal weight bearing asymmetry (WBA) on standing balance in a two-scale test.

The subjects were blinded.

The measurements and the treatments were carried out by two different persons. The examiner was familiar with the two-scale test and blinded. And the treating Osteopath has an experience of more than 10 years with the Strain/Counterstrain-technique and HVLA-technique on the upper cervical spine.

Figure 1: Studydesign



3.2 SUBJECTS

The subjects were selected out of all new patients at the private practice of the author, who were willing to take part in this study. Only adult women were considered for the study group. It consisted of women between 18 to 42 years of age.

The women were finally matched in the study group only if the two-scales-test proved a weight bearing asymmetry of more than 4 kg between the right side and the left side.

Group 1:

The first group consisted of 20 subjects, which were treated at the upper cervical spine with the Strain/ Counterstrain technique.

Group 2:

The control group consisted of 20 subjects, which were treated at the upper cervical spine with the Sham-manipulation.

Group 3:

The second group consisted of 20 subjects, which were treated at the upper cervical spine with the osteopathic HVLA-technique.

3.3 SUBJECT SELECTION

The patients were invited to participate in the study, and if interested they were given written information regarding the experimental procedure (Appendix 1). If they were willing to participate, each person was asked to complete the screening questionnaire (Appendix 1), and read the attached consent form (Appendix 2).

Inclusion and exclusion criteria were checked with the screening questionnaire (Appendix 1).

3.3.1 INCLUSION CRITERIA

The inclusion criteria are a standing imbalance of more than 4 kg unequal weight distribution between the right side and the left in the two-scales-test.

A functional disorder of the cervical spine is seen as a common cause for a longer lasting vestibulo-spinal disturbance of equilibrium. To create objectivity, the cervical nystagmus was measured with Frenzel glasses and portrayed with an electro-nystagmo-graph and compared with the WBA. The connection between a functional disorder of the cervical spine and the capability for vestibulo-spinal reaction and the asymmetry in weight bearing in still upright standing seem probable. (Hülse & Hölzl, 2000; Lewit, 1997; Lewit, 1986; Neuhuber, 1998; Biesinger, 1997).

Only women were chosen for this study, in order to increase the significance. Due to biological factors, early development, early social learning and differences in experiences, a gender difference could distort the research results (Unruh, 1996; Wiesenfeld-Hallin, 2005).

3.3.2 Exclusion criteria

- Older than 42 years

  In older people the WBA-factor could increase due to an impairment of the sensor-motor system (Dault et al., 2003; Shaffer et al., 2007).

- Younger than 18 years.

  The processing of information in the nervous system differs between a child, an adolescent, and an adult. At about the age of 16 the vestibular and visual afferent systems reach the level of an adult (Steindl et. al., 2006).

- Neurological diseases

  Information from the spinal and vestibular afferences gets processed and integrated in the brainstem and cerebellum. Pathologies lead to dizziness and a difference in the postural behavior of standing (Hülse & Hölzl, 2000; Marigold et al., 2006; Genthon et al., 2008)

- Ontological diseases

  In the literature there is a discussion about the influence of the dysfunctions of the temperomandibular system and the spine. The functional dependency between head- and body posture and the occlusion of the jaw is discussed. (Gutmann, 2008)

- Vestibular diseases

In order to examine the cervical influence on the vestibulo-spinal ability to respond as a basis for the method of measurement, it is necessary to screen out pathological diseases of the labyrinth (Hülse & Hölzl, 2000).

3.3 The two-scale test

The two-scale test was chosen as method of examination for the reasons specified below. One mechanism for the balance reaction is a performance of the vestibular core complex in the medulla oblongata, which strongly depends on the afferents from the craniocervical levels of the spinal cord and the vestibular afferents, a change in the afferent regions of origin can be proven by the change in standing weight bearing asymmetry (Arvidsoson & Pfaller, 1990; Zenner, 1998; Neuhuber, 1998; Lewit, 1997; Lewit, 1986).

Validity and Reliability

There are two types of measuring methods to measure the WBA – the two-scale-test and double-force-plattforms. Force plattforms are commonly used in posturography to examine the body sway (Winter et. al., 2003).

Double force plattforms are often used in studies about the connection between weight-bearing asymmetry (WBA) and postural control, in order to document the weight distribution as well as the postural sway in the A-P and the M-L planes (Anker et al., 2008; Blaszczyk et al 2000; Marigold et al., 2006; Genthon & Rougier, 2005).

The two-scale-test was used in pure WBA studies, in order to measure the weight distribution in the frontal plane. The difference between the leg with the heavier load and the one with the lighter load is stated in kg (Hülse & Hölzl, 2000; Lewit, 1997; Lewit, 1986). In his work with the double-force-plattforms from 2000 Blaszczyk et al. describe that the WBA evens out within 20s and then stays stabil, so that the postural sway in the M-L plane can be disregarded, since only a weight bearing asymmetry of more than 2 kg is clinically relevant (Lewit, 1993). In addition, as the WBA increases, the hip load/ unload-mechanism of the M-L sway is reduced and the A-P sway is increased (Anker et al, 2008).

Lewit carried out a study with 106 randomized patients, in 1986. He examined the upper cervical spine for restriction of motion, gave the two-scale-test, and tested the nystagmus in the final position with Frenzel glasses. In 56 subjects, he found an unequal distribution of weight of more than 4 kg with the two-scale-test. All these patients had a restriction of motion in the upper cervical spine. After manipulative treatment with a HVLA-technique, the unequal distribution of weight was considerably improved as proven by the two-scale-test and the nystagmus in the final position tested with Frenzel glasses (Lewit, 1986).

For financial reasons the author decides to use the two-scale-test, since only the WBA is measured.

Procedure

The person placed each foot on one scale, for the two-scales-test and then was requested to distribute the weight equally between the two feet. The subject is not allowed to look at the measurement readings. The examiner waited until the subject had finally settled at one value. Then after 20 s the examiner read the difference between the two scales. The unequal distribution of weight between the feet is a measure of the dysfunction of the regulation system for the weight bearing asymmetry.

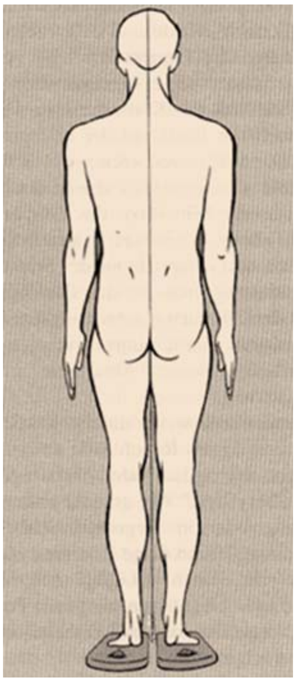


Figure 2: Two-scale test

(Adapted from Lewit, 1998)

Measuring tolerance

The measuring instrument is gauged with a measuring tolerance of 0.1 kg and produced by the Soehnle company.

3.4 Experimental procedure

3.4.1 Pre-experiment requirements

The measurements and the treatments always took place in the same room, with good illumination and at pleasant room temperature. The patients were appointed about noon in order to minimize fluctuation over the course of the day such as morning stiffness or tiredness in the evening. Each patient was asked again to read the screening questionnaire and experiment procedure.

- If their answers to the screening questionnaire had changed they were asked to inform the examiner. If still eligible for the study, each subject was asked to read and sign the consent form (Appendix 2).

- Each subject was reminded that if they should experience any pain or discomfort they should inform the examiner and the experiment would be stopped.

- If the subject was unable to provide details about their height or weight in the screening questionnaire, these measurements were additionally taken by the examiner (Bauer, 2004).

3.4.2 Allocation to subject groups

The 60 Subjects were then randomly assigned to one of the three groups, the Strain/Counterstrain-Technique group (n=20), the control group (n=20) or the HVLA-Thrust group (n=20).

3.4.3 Measurement procedure

Pre-test measurement (M1)

Immediately before treatment, a measurement was taken with the two-scale test.

- The subject was requested to distribute her weight evenly on the two legs.

- The head had to be held horizontally.

- The subject had to look straight ahead, with eyes closed in this position.

- The mouth was open slightly.

After the subject had settled with a weight distribution, the difference was read in kg, in such a way that the patient had no chance to see the result.

Intervention

Directly after the measurement (M1) the Intervention was carried out separately in each of the three groups.

Post-measurement (M2)

After three minutes rest, the subject was instructed to walk around the room for three minutes. Afterwards, another two-scale-test measurement was taken using the same procedure as in the first measurement (Bauer, 2004).

Measurement after two weeks (M3)

After two weeks time, the subjects were appointed once more and another two-scale-test measurement was taken.

3.4.4 INTERVENTION

group 1: Intervention with the Strain/Counterstrain-Technique

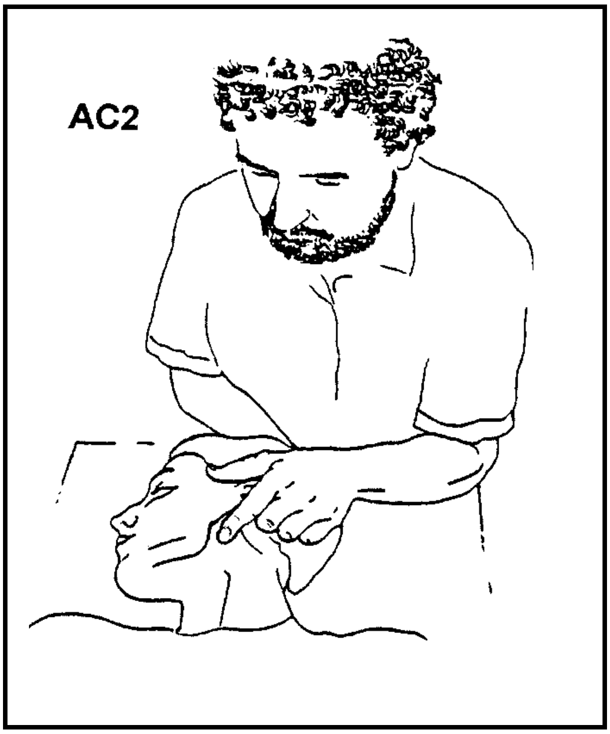
The examiner palpated the tender points allocated to the first two cervical segments according to the Jones procedure. Seven pairs of tender points according to Jones (a total of 14 points) have been examined in each subject. Four pairs of tender points are allocated to the C0 / C1 – segment (called A1C regular, A1C rare, P1C regular and P1C exception in Jones‘ encyclopaedia), three pairs correspond to the C1 / C2 – segment (called A2C, P2C midline and P2C lateral) (Jones, 1989; McPartland, et al., 1998).

The examiner localized the tender points according to their anatomic position. Hypersensitive points were palpable also where small nodes existed. The examiner pressed on the tender points with a force of approximately 4kg per 1.54 cm^2, this is considered standard in fibromyalgia research (Wolf, et al., 1990).

The chosen tender points were then treated for 90 seconds with the Strain/Counterstrain technique.

Figure 3: Treating with Strain/Counterstrain technique

(Adapted from Yates u. Glover 1995)



<u>group 2: Intervention with a sham-manipulation (control group)</u>

The same procedure as used for the Strain/Counterstrain-Technique group was performed with the control group. Instead of applying a Strain/Counterstrain technique, a sham manipulation was applied between the first and second measurement. The practitioner laid both his hands on the skull for 90 seconds similar as for a cranial base release.

<u>group 3: Intervention with the HVLA-Thrust technique</u>

After the safety tests, the results were compared with the case history and interpreted (Gibbons & Tehan, 2004).

After completing the standard safety procedures and receiving the subjects approval, the intervention was started. The upper cervical spine was examined for dysfunctions according to osteopathic principles. Then all somatic lesions were corrected with a HVLA-technique on the basis of Prof. Laurie Hartmann (Hartmann, 1997). The levels of the upper cervical spine that were treated were the atlanto-occipital joint (C0/C1), the atlanto-axial joint (C1/C2) and C2/C3.

4. Results

Raw data is outlined in the Appendix.

4.1 Subject analysis

group 1: Intervention with the Strain/Counterstrain-Technique

The **Counterstrain-technique group** consisted of 20 subjects (n=20), only female.

group 2: Intervention with a sham-manipulation

The **Control group** consisted of 20 subjects (n=20), only female.

group 3: Intervention with the HVLA-Thrust technique

The **HVLA-technique group** consisted of 20 subjects (n=20), only female.

4.2 STATISTICAL ANALYSIS

The issue of improvement of the weight bearing asymmetry through treatment was evaluated with regards to quantity. The weight bearing asymmetry between the feet was the dependent variable. The study design was that of two factors with a three-stage group factor (control group, Counterstrain-technique group and HVLA-technique group) and a three-stage factor of measurement repetition (pre-treatment, post- treatment, follow up). Non-parametrical methods were referred to in addition to the variance analysis in order to secure the determined results of the variance analysis. An alpha level of $p<0.05$ was accepted as significant.

Statistical analysis was divided into two sections:

- Primary analysis considering the experimental hypothesis.

- Secondary analysis looking for the effects of weight, age and size

4.2.1 PRIMARY ANALYSIS – VERIFICATION OF EFFECT

Parametrical tests (variance analysis) and non-parametrical tests were performed to check whether the treatment as independent variable had a significant effect on the difference in weight distribution as the dependent variable. The operational sign of the measurement readings must not be considered in this quantitative evaluation as positive and negative readings, which only mean that more weight is placed on the left or right foot, would offset each other in determination of the mean value.

4.2.2 DIFFERENCES WITHIN THE GROUPS

Verification of the group's measurement repetition

Table 1: Significance chart: Uni-factorial variance-analysis: measurement repetition factor, separately for all 3 groups (=single-comparison-test)

Dependent variable: weight bearing asymmetry	**Variance-analysis**	**Friedman's Rangvarianzanalyse**
Counterstrain group	**0,0001**	**0,00001**
Control group	0,8645	0,6146
HVLA-technique group	**0,0001**	**0,00000009**

Table 2: Significance chart: Uni-factorial variance-analysis: Profile-calculation

Profile-calculation			
	Overall Significance	Measurement 1 vs. 2	Measurement 2 vs. 3
Counterstrain group	**0,0001**	**0,0001**	0,2155
Control group	0,8645	0,7058	0,6530
HVLA-technique group	**0,0001**	**0,0001**	**0,0292**

Table 3: Significance chart: Uni-factorial variance-analysis: Contrast-calculation

Contrast-calculation			
	Overall Significance	Measurement 1 vs. 2	Measurement 1 vs. 3
Counterstrain group	**0,0001**	**0,0001**	**0,0001**
Control group	0,8645	0,7058	0,8685
HVLA-technique group	**0,0001**	**0,0001**	**0,0001**

The charts above portray the significances of the uni-factorial variance-analysis with the measurement repetition factor shown separately for the three groups. Since there are 3 measurement times, the amount of difference between the measurement times has to be determined via contrast- and profile calculation (single-comparison-test for the measurement repitition)

The control group does not show significant differences concerning the measurement repetition, meaning that there is no improvement concerning the weight bearing asymmetry at the 3 times of measurement.

The counterstrain-technique group shows highly significant differences concerning the measurement repetition. These are non-parametrically confirmed by Friedman’s rank-variance-analysis. The highly significant changes here, are between the first and second measurement. No significant changes can be seen between the second and third measurement. This however secures the sustainability of the treatment‘s success.

The HVLA-technique group also shows highly significant differences concerning the measurement repetition, which are non-parametrically confirmed by Friedman’s rank-variance-analysis (Rangvarianzanalyse). Here the highly significant changes can be seen between the first and second measurement. But significant changes can also be seen between the second and third measurement, this means, that not only has the treatment’s sustainability been proven, but also a further significant improvement has taken place at the third measurement.

The following tables and graphs portray the results of the significance tests.

Table 4: Control group over the three measurement times

	N	Mean	95%Confidence (±)	Std.error	Std.dev.
M1 (kg)	20	6,62	0,83	0,398457552	1,781956347
M2 (kg)	20	6,55	0,92	0,437847606	1,958114023
M3 (kg)	19	6,77	0,86	0,41132027	1,79290349

Table 5: Counterstrain-technique group over the three measurement times

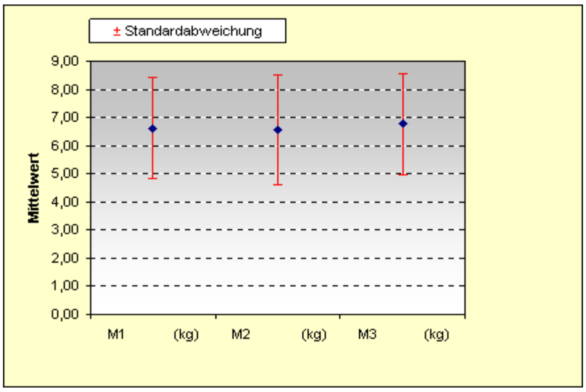
	N	Mean	95% Confidence (±)	Std.error	Std.dev.
M1 (kg)	20	6,38	1,14	0,543264983	2,429554865
M2 (kg)	20	2,35	1,02	0,485066463	2,16928317
M3 (kg)	20	1,84	0,80	0,384255945	1,718444829

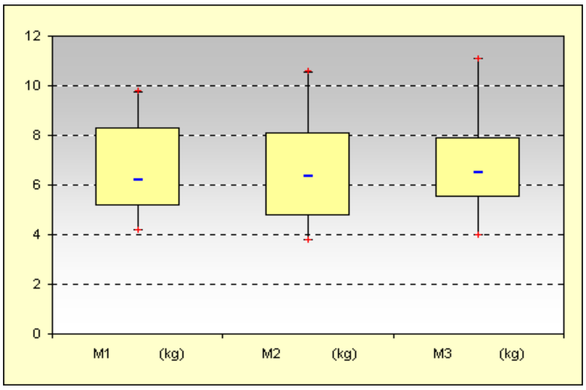
Table 6: HVLA-technique group over the three measurement times

	N	Mean	95% Confidence (±)	Std.error	Std.dev.
M1 (kg)	20	8,08	1,43	0,683782052	3,0579663
M2 (kg)	20	1,29	0,62	0,294178159	1,315604724
M3 (kg)	20	0,75	0,37	0,175989683	0,787049788

Graph 1: Control group over the three measurement times

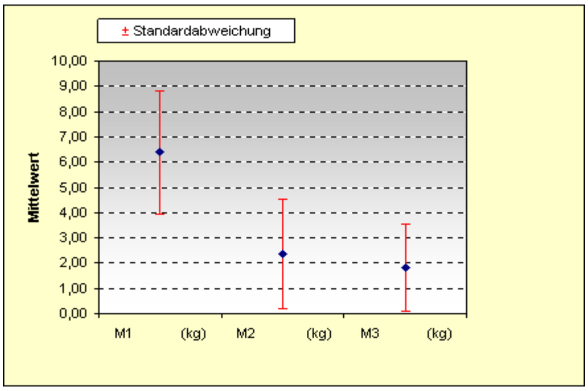
Mean value diagram (Variance analysis) | Box-Plot (non-parametrical)

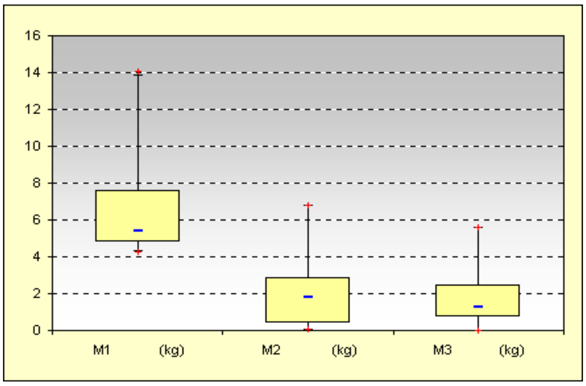




Graph 2: Counterstrain-technique group over the three measurement times

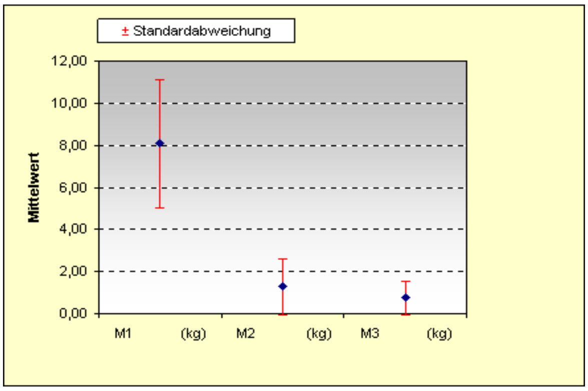
Mean value diagram (Variance analysis) | Box-Plot (non-parametrical)

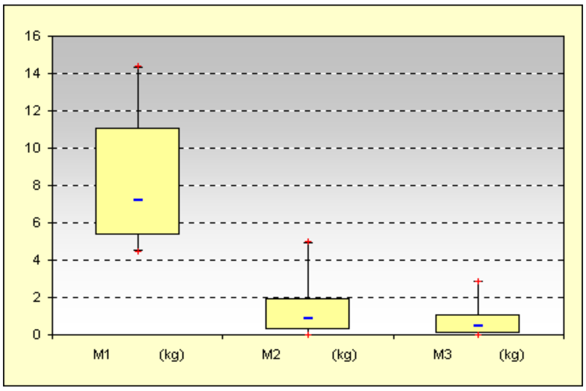




Graph 3: HVLA-technique group over the three measurement times

Mean value diagram (Variance analysis) | Box-Plot (non-parametrical)





4.2.3 Differences between the groups

Using parametrical tests (variance analysis) and non-parametrical tests (Kruskal-Wallis-Test), one checks whether the treatment, as an independent variable, has a significant effect on the weight bearing differences, as a dependant variable.

The algebraic sign of the measurement results should not be integrated into the quantitative evaluation, since positive and negative measurements, which only indicate an increased weight bearing of the left or right foot, will cancel each other out in the determination of the mean.

Table 7: Significance chart: Uni-factorial variance-analysis: group repetition factor, separately for all 3 times of measurements

depend variable weight bearing asymmetry	Variance-analysis	Kruskal-Wallis Test
1. Measurement	0,0720	0,1184
2. Measurement	**0,0001**	**00001**
3. Measurement	**0,0001**	**0,0001**

The data in the chart are the α-mistakes. They've been taken from the listing of the statistical analysis.

There are group differences close to a marginally significant before the treatment (Variance-analysis; 1.Measurement: 0,0720). However, they could not be confirmed with the Kruskal-Wallis test. After the treatment there are significant group differences at the second and third measurement. These can be proven by the parametrical and non-parametrical procedures.

The particular single-comparison-tests show the following:

The variance-analysis proved, that there is a difference between the groups. The single-comparison-test indicates between which groups there is a significant difference and how big the difference is.

1. Time of examination:

Table 8: 1. Time of examination: Critical mean differences between group pairs (top right) and significance evaluation (bottom left):

	(Mean)	Counterstrain	Control group	HVLA- group
Counterstrain	**6,38**	------	**1,569520679**	**1,650772185**
Control group	**6,62**	**No**	------	**1,569520679**
HVLA- group	**8,08**	**Yes**	**no**	------

subgroup 1: Counterstrain group; subgroup 2: Control group, HVLA- group;

At the first examination time there is a significant difference between the mean of the Counterstrain technique and that of the HVLA-Thrust technique. (The mean of the HVLA-Thrust technique is significantly higher than with the Counterstrain technique). There are no significant mean differences between the Counterstrain technique and the control group. There are also no significant mean differences between the HVLA-Thrust technique and the control group.

Table 9: 1. Time of examination M1 (kg) according to group

	N	mean	95% Confidence(±)	Std.error	Std.Abw.
Counterstrain	20	6,38	1,14	0,543264983	2,429554865
Control group	20	6,62	0,83	0,398457552	1,781956347
HVLA- group	20	8,08	1,43	0,683782052	3,0579663
Total sample	60	7,026666667	0,659066188	0,329362221	2,551228794

2. Time of examination:

Table 10: 2. Time of examination: Critical mean differences between group pairs (top right) and significance evaluation (bottom left):

	(Mean)	HVLA- group	Counterstrain	Control group
HVLA- group	1,285	----	1,171697562	1,23235442
Counterstrain	2,35	No	----	1,171697562
Control group	6,55	Yes	Yes	----

subgroup 1: Counterstrain group; subgroup 2: Control group, HVLA- group;

At the second examiniation time the means of the Counterstrain- and HVLA-technique group show a significant difference to the mean of the Control group.

Table 11: 2. Time of examination M2 (kg) according to group

	N	Mean	95% Confidence(±)	Std.error	Std.Abw.
Counterstrain	20	2,35	1,02	0,485066463	2,16928317
Control group	20	6,55	0,92	0,437847606	1,958114023
HVLA- group	20	1,29	0,62	0,294178159	1,315604724
Total sample	60	3,395	0,755867994	0,377738027	2,925946175

3. Time of examination:

Table 12: 3. Time of examination: Critical mean differences between group pairs (top right) and significance evaluation (bottom left):

	(Mean)	HVLA- group	Counterstrain	Control group
HVLA- group	0,745	----	0,949253803	1,011427278
Counterstrain	1,84	Yes	----	0,961662876
Control group	6,768421053	Yes	yes	----

subgroup 1: Counterstrain group; subgroup 2: Control group, HVLA- group;

At the third examination time there is a significant difference between the means of all three groups. The HVLA-technique group shows the lowest mean.

Table 13: 3. Time of examination M3 (kg) according to group

	N	**mean**	**95% Confidence (±)**	**Std.error**	**Std.Abw.**
Counterstrain	20	1,84	0,80	0,384255945	1,718444829
Control group	19	6,77	0,86	0,41132027	1,79290349
HVLA- group	20	0,75	0,37	0,175989683	0,787049788
Total sample	59	3,055932203	0,783292286	0,391308787	3,005699826

4.2.4 Secondary analysis - Evaluation of factors influencing the data

At first it is evaluated whether the groups differ in the influencial factors of age, weight and height.

Table 14: Uni-factorial variance-analysis: Group differences concerning the factor group for the possible influencial factors of age, weight and height:

	ANOVA	Kruskal-Wallis Test
Age	0,8079	0,8333
weight	0,4592	0,5049
height	0,6997	0,4102

There are no significant group differences concerning the influencial factors of age, weight and height. Concerning this all three treatment groups start under the same precondition.

The following single-comparison-tests show the means concerning the dependent variables and which distance would have been necessary for a significance.

Table 15: Single-Comparison-test for age (y):

	(Mean)	HVLA-technique	Counterstrain	Control group
HVLA-technique	30,35	----	4,784078666	5,031742559
Counterstrain	30,95	No	----	4,784078666
Control group	31,9	No	No	----

Critical mean differences between group pairs (top right) and significance evaluation (bottom left)

Table 16: Single-Comparison-test for weight (kg):

	(Mean)	Control group	Counterstrain	HVLA-technique
Control group	62,18	----	6,182185027	6,502226589
Counterstrain	62,495	No	----	6,182185027
HVLA-technique	65,685	No	No	----

Critical mean differences between group pairs (top right) and significance evaluation (bottom left)

Table 17: Single-Comparison-test for height (cm):

	(Mean)	Counterstrain	Control group	HVLA-technique
Counterstrain	164,1	----	4,151932809	4,366871549
Control group	164,4	No	----	4,151932809
HVLA-technique	165,75	No	No	----

Critical mean differences between group pairs (top right) and significance evaluation (bottom left).

In order to control possible factors influencing the data, the factors age, weight and height and their interaction with the group factor are evaluated before and after the treatment.

Conclusion: At no time of measurement, a significant influence of the variables ‘age’, ‘weight’ and ‘height’ could be shown, that would have been confirmend non-parametrically with the Kruskal-Wallis-Test.

4.2.5 Statistical conclusion

The statistical evaluation of the data proves the effect of the Counterstrain technique and the HVLA-Thrust technique for the weight bearing asymmetries.

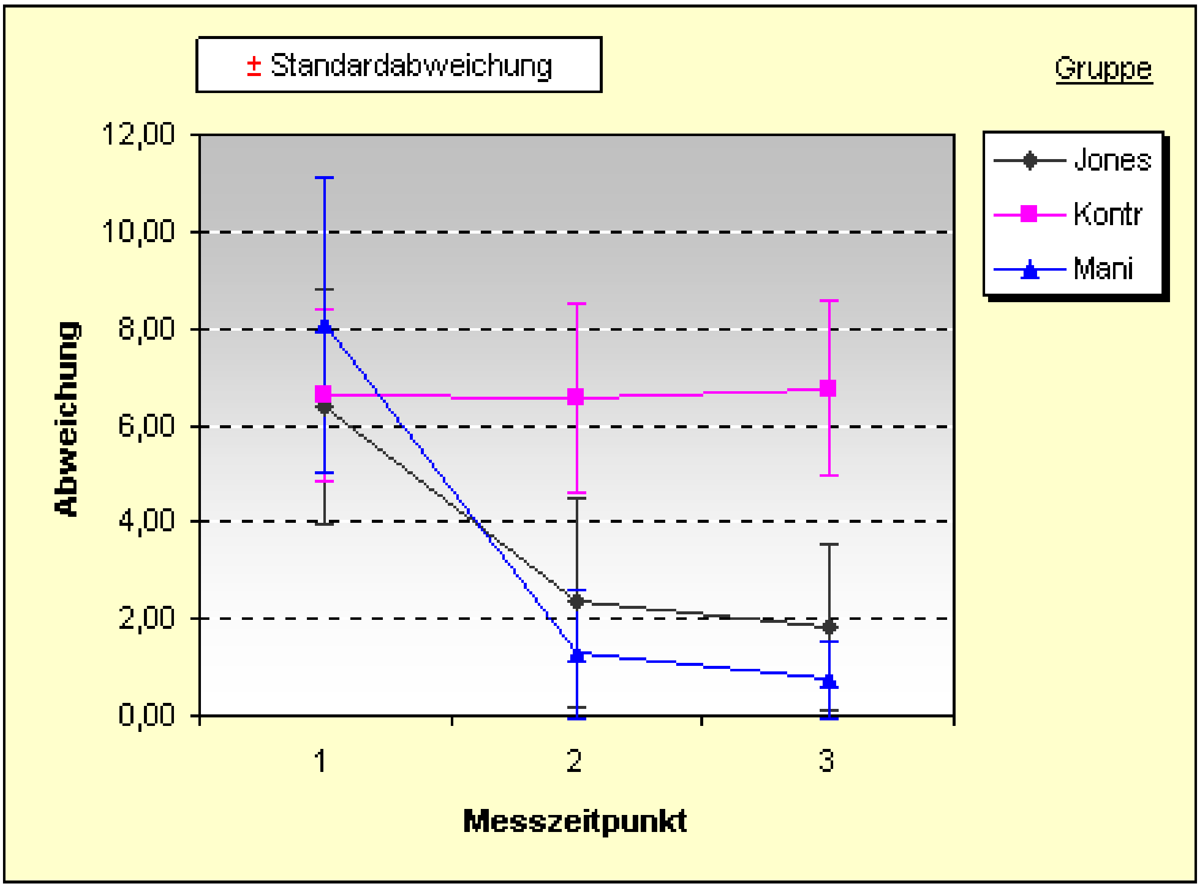
The group differences are not significant at the first measurement, which means that all groups start with almost identical conditions concerning the weight bearing asymmetries (the HVLA-technique group shows slightly higher weight bearing asymmetries than the other two groups). After treatment (second measurement) the Counterstrain technique group and the HVLA-technique group differ significantly from the control group. These differences increase at the third measurement (follow up). We can conclude that the treatment with the Strain/Counterstrain technique and the HVLA-Thrust technique brings sustainable results.

However, the evaluation of the measurement repetition shows, that the Strain/Counterstrain technique and the HVLA-Thrust technique don't have the same effect. Since the HVLA-Thrust technique in the measurement repetition even shows another significant improvement between the second and third measurement, it can be seen as the more effective treatment procedure. This is confirmed by the third measurement of the HVLA-technique group showing the least average weight bearing asymmetry after having started with the largest average weight bearing asymmetry in the first measurement (also see the following graph).

The control variables 'height', 'weight' and 'age' have no statistically relevant influence on the dependant variable of weight bearing asymmetry.

The following graph clearly shows the whole situation of the three groups at the three times of measurement.

Graph 4: variable of measurement according to time of examinations and groups



Counterstrain-technique group (Jones), Control group (Kontr), HVLA-technique group (Mani), Time of examination (Meßzeitpunkt) and standard deviation (Standardabweichung);

5. DISCUSSION

5.1 INTERPRETATION OF RESULTS

5.1.1 INTERPRETATION OF THE TWO-SCALE TEST

The two-scale-test measures the weight bearing asymmetry of the subjects, meaning their capability to distribute their weight evenly on both legs. This weight distribution between the left and the right foot, measured in kg, can vary.

In same studies with the double-force-plattforms has described that the WBA evens out within 20s and then stays stabil, so that the postural sway in the M-L plane can be disregarded, since only a weight bearing asymmetry of more than 2 kg is clinically relevant (Lewit, 1993; Blaszczyk et al., 2000). Considering the measurement tolerance of the used device of 0,1kg, it was determined that only results with a weight bearing asymmetry of >2 kg should be considered as clinically relevant. This was also supported by the results of the control group (n=20). The mean of the first measurement (M1) of 6,62 kg before the sham-manipulation, changed by 0,07 kg to 6,55kg (M2) afterwards. Two weeks later the comparison with the first measurement showed a difference of 0.148421 kg (M3-M1). This shows that the variation of the control group is clearly smaller than the clinically relevant number of 2kg weight bearing asymmetry and can therefore be disregarded.

5.1.2 CONTROL VS INTERVENTION GROUPS – POPULATION COMPARISON AND MEASUREMENT EFFECT

The group differences (graph 1) were measured before the intervention with a variance-analysis (p=0,0720) and the Kruskall-Wallis Tests (p=0,1184). The variance-analysis shows marginally significant group differences. However, these could not be confirmed by the Kruskal-Wallis Test. The data of the non-parametrical test (0,1184 KWT) proves, that all 3 groups are comparable.

The results of the single-comparison-test are also interesting. At the first time of examination there was a significant difference between the mean of the Jones- (6,38 kg) and the HVLA-thrust technique (8,08 kg) (the mean of the manipulation group was significantly higher than that of the Jones group). This means that both research groups did not start with absolutely identical preconditions; the HVLA-thrust technique group had a worse starting condition.

There were no significant differences between the Jones- and the control group, aswell as the HVLA-thrust technique and the control group.

Later, at the time of the second measurement right after the intervention, the mean of the Jones- and the HVLA-thrust technique group differed significantly from the mean of the control group. There was an obvious improvement of both research groups compared to the control group. However, there was no significant difference between the Jones- and the manipulation group.

At the repeated measurement two weeks later (third time of examination), the results of the research groups where significant again, meaning that the weightbearing asymmetry stayed significantly reduced. However, the HVLA-thrust technique group showed the lowest mean of all three groups! This means, that at the third measurement, there was a significant difference between the Jones- and the manipulation group, that did not exist at the second measurement.

5.1.3 Experimental hypothesis

The statistical evaluation could not confirm the experimental hypothesis, that the Jones-technique and the manipulation at the upper cervical spine have the same significant effect on the control of balance. It showed that both techniques did not have the same efficacy. The HVLA-thrust technique showed significant improvements between the second and third measurement and can therefore be evaluated as the more effective treatment procedure. The null-hypothesis was thereby confirmed.

5.1.4 Clinical relevance

Besides statistical relevance, there is also the question of clinical relevance. The ability to distribute the weight evenly on the two legs has considerably improved in the intervention group, the mean of the strain/counterstrain group (n=20) before treatment (M1) of 6.38 kg difference in weight bearing asymmetry has changed by 4,03 kg (M1 – M2) to 2.35 kg (M2) and the mean HVLA thrust group (n=20) before treatment (M1) of 8,08 kg difference in weight bearing asymmetry has changed by 6,79 kg (M1 – M2) to 1,29 kg (M2) after intervention. After 2 weeks the strain/counterstrain group was improved by 0.51 kg (M2-M3) to a mean of 1,84 kg (M3) and HVLA-group was improved by 0.54 kg (M2-M3) to a mean of 0.75 kg (M3)

Considering the individual values of the strain/counterstrain group (n=20) there are three subjects, which after two weeks settled back on the old pre-treatment value. Poor performance of the practitioner might be one possible cause. Maybe a structure belonging to the restriction of motion was irritated and caused a change in the afferent input into the central nervous system, which had a negative effect on the standing balance. On the other hand, the restriction of motion might be a necessary compensation in these three subjects. Only one technique was performed on the subjects, but not a complete osteopathic treatment, therefore the therapeutic area might not be the upper cervical spine region, but elsewhere in the body.

The other 17 subjects in the strain/counterstrain group however improved their weight bearing asymmetry by more than 2 kg.

All 20 subjects of the HVLA-thrust group improved by values noticably higher than 2 kg and then, after the third measurement, settled at therapeutically inconspicous values of 2,9 to 0 kg weight bearing asymmetry (Hülse & Hölzl, 2000).

5.1.5 Secondary analysis

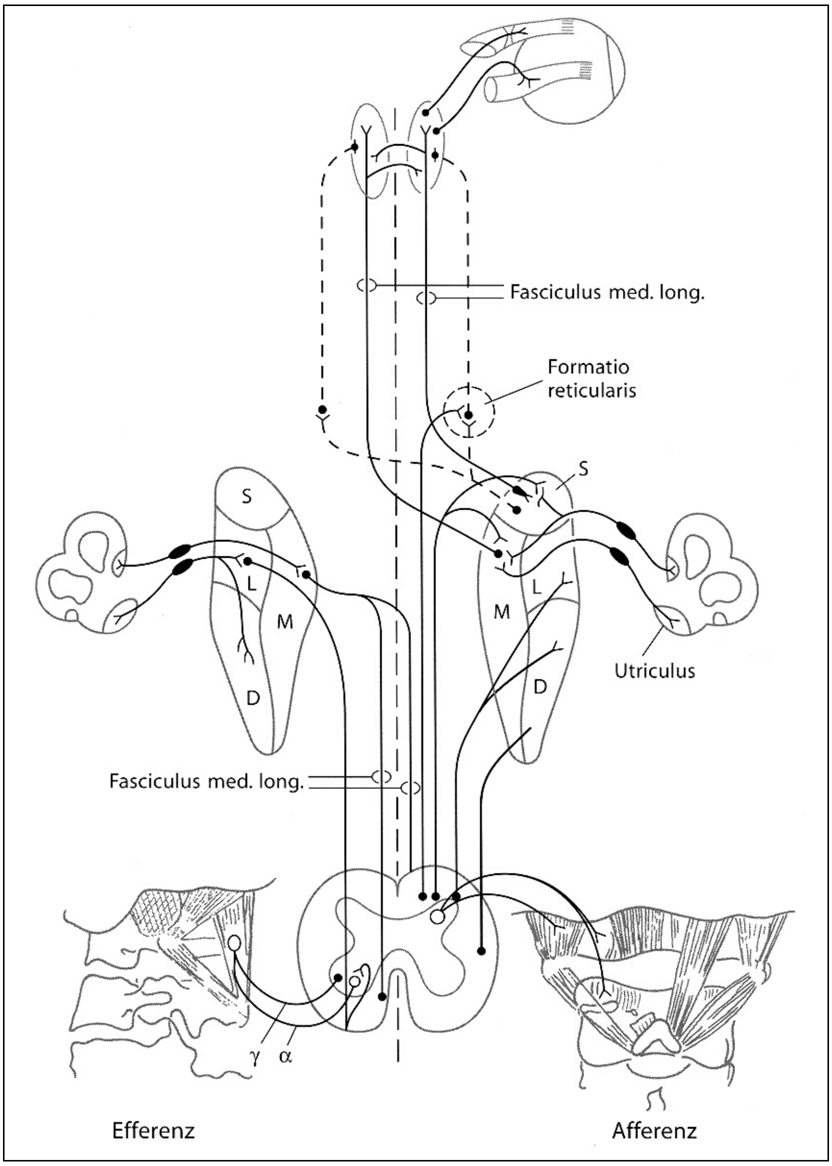
The control variables height, weight and age have no statistically relevant impact on the dependent variable weight bearing asymmetry.

5.2 PROPOSED MECHANISMS OF EFFECTS

The improvement of weight bearing asymmetry can only be explained by a changed impact of the neck afferents on the vestibular cores (Neuhuber, 1998; Lewit, 1997; Hülse & Hölzl, 2000).

Figure 4: Chart of the connections of the vestibular nuclei complex

(According to Brodal 1987)



S Nucleus vestibularis superior, L Nucleus vestibularis lateralis, D Nucleus vestibularis descendens, M Nucleus vestibularis medialis

There are three explanatory models for the improved afferent influence from the upper cervical spine on the control of balance: the nociceptive, the proprioceptive hypothesis and a mechanical component model (Gibbons & Tehan, 2004; Jones, 2005; Parsons & Marcer, 2006).

5.2.1 THE NOCICEPTIVE MODEL

The influence of the HVLA-thrust and strain/Counterstrain on the nociceptive system is discussed in osteopathic literature (Gibbons & Tehan, 2004; Hartmann, 1997). The regulation of equilibrium at the upper cervical spine does not seem probable. The nociceptive afferences end at other ascending tracts than the proprioceptive afferences at the posterior horn of C2 and C3 (Neuhuber, 1998).

The nociceptive fibers extend to the Nucleus spinalis nervi trigeminus but not to the vestibular complex. This leads to the assumption that of the two model explanations for the strain and counterstrain method (the nociceptive and the proprioceptive hypothesis) the proprioceptive thesis is more confirmed, at least at the head joints (Yates and Glover 1995; Bailey and Dick, 1992).

5.2.2 THE PROPRIOCEPTIVE THESIS

A direct projection of the vestibular nucleus from the proprioceptive neck muscle afferences probably come from the cervical segments C2-C4 via synapsing of the proprioceptive spinal skin and muscle afferences in the posterior horn (Hülse &Hölzl, 2000). This was proven dominant in rats and cats (Bankoul & Neuhuber, 1992).

After an anaesthesia of the C2 nerve root in patients with cervical headaches, a gait deviation toward the anesthesized side was noted (Dietrich et al., 1993). Several authors describe a segmental information processing disturbance in connection with a cervical movement disorder (Lewit, 1997; Jones, 2005). It is assumed that both the HVLA-thrust technique and the Strain/counterstrain have an influence on this somatic dysfunction (Gibbons & Tehan, 2004; Hartman, 1997; Jones, 2005; Liem & Dobler, 2005). In a 2006 study, the proprioceptive reflex activity of the M. triceps surae was measured before and after a Strain/counterstrain treatment in patients with achilles tendinitis The use of Strain/counterstrain produced a 23,1% decrease in the amplitude of the stretch reflex (Howell et al., 2006).

5.2.3 The mechanical explanatory model

There are two important parameters for the mechanical explanatory model: an impact on the trophic of the head joint region and improvement of the freedom of motion (Hartmann, 1997).

In the study named above, of subjects with Achilles tendinitis, in addition to the improvement of the proprioceptive reflex activity, one also found a significant clinical improvment in soreness, stiffness and swelling. This was discussed as an influence on the tissue's local trophicity (Howell et al., 2006).

The mechanical mobility of the head joints seems to have an important influence on the vestibular nuclei via the activation of proprioceptive joint receptors. Strain/counterstrain is not said to have a direct influence on the joints, but rather an indirect one via the muscles, since there is no mechanical force brought on to the joints. This is in contrast to the HVLA-technique, where a direct force is used on an unphysiological barrier. This leads to a decoaptation of the joint surfaces and a typical popping sound. In the impinchement theory it is discussed whether meniscus-like joint-folds are released with the direct technique. In the cervical aswell as the lumbar area of the spine, one often finds crescent shaped joint-folds of the synovial membrane reaching in between the joint surfaces at the spinal joints. (Struwe, 2007).

5.3 Possible sources of error

Several possible sources of error can be discussed.

5.3.1 Study design

It could be argued that there was a potential risk of examiner bias and in order to reduce this risk it may have been preferable to operate a double blind procedure (Hicks, 1999), where both the examiner and subject were blinded to the experimental hypothesis. In this study, the subjects were blinded, they didn't know whether they belonged to the control group or to the intervention groups. They could not see the measuring data. The examiner and the treating Osteopath are two different persons. The examiner was blinded. However, in this study design the person performing the intervention had to know which group the subjects belonged to.

5.3.2 Subject group

It would have been preferable to have used a larger amount of subjects, but this was restricted by practical constraints of selecting subjects who met the inclusion criteria from a relatively small population. This would have made extrapolation of data to the general population more accurate.

Furthermore, the group only consisted of women, and the age was limited from 18 to 42. The reasons herefore is that men and women have a different risk of dissection of the arteria vertebralis, and women after menopause are subjected to other hormonal influences (Ringelstein, 1997). Limiting the age range and the sex of the subject group reduces the accuracy of extrapolation of the data to the general population.

5.3.3 Subject sources of error

A possible source of error is that the subjects may not have fully complied with the pre-experiment requirements

5.3.4 Examiner sources of error

A possible source of error might be the performance of the treatment technique, however the treating Osteopath has already performed the strain/counterstrain and HVLA-thrust technique for more than 15 years in his everyday practice. He is teaching the techniques at Osteopathic school`s. For future studies, it would be ideal to have several experienced examiners.

5.4 Clinical implications for osteopathy

The findings of this study support earlier research (Bauer, 2004; McPortland, et al., 1997; Lewit, 1986) and they also demonstrate a relationship between the treatment of the cervical spine, in particular the upper cervical spine, and its peripheral effect.

5.4.1 HVLA-thrust versus strain/counterstrain technique

Trying to answer the question whether the strain/counterstrain technique is sensible as a supplement or as an alternative, one has to look into the advantages and disadvantages of a thrust technique. The clear advantage of manipulation against the strain and counterstrain technology is the mechanical component with its direct impact on the tissue and the required time. This is opposed by the rare but bigger risks of complications. Research of the literature on possible complications after manipulation of the cervical spine showed that all occurrences could have been avoided if safety standards had been adhered to, with the exception of cerebral blood circulation problems (Szabela, et al., 1997; Hurwitz, et al., 1996; Gouveia, et al., 2009).

5.4.2 Vascular safety tests

Some studies repeatedly doubted the validity of vascular safety tests. The concept of unilateral or even bilateral mechanical obstruction of the blood circulation of the A. vertebralis as the cause of vertebrobasilary symptoms goes back – among other things – to rotation experiments and flow measurements of the vetebral arteries of corpses. But the authors had not considered that rotations of the scale as possible on relaxed corpses are not possible in living people because of the protective reflexes under physiological conditions, unless applied with considerable force, or to narcotized patients (Ringelstein, 1997; Weingart and Bischoff, 1997).

In the meantime, modern methods of examination, such as the color-coded duplex sonography and the clearly defined test design used by different centers in the FRG, Canada and England have tested and confirmed that the blood flow in the A. vertebralis, regardless of the degree of rotation, traction or sideways inclination, is normal even and regular (Weingart and Bischoff, 1997 and 1992; Thiel, 1991).

5.4.3 Risks of dissection of the A.vertebralis

If for example the head is rotated extremely to the right until the final position, which is possible as far as 90°, or even more in particular in adolescents with elastic tissue, the left A. vertebralis in the foramen costotransversarium is projected, and bent sharply. Extreme rotational movements could lead to functional obstruction of the vertebral artery, which is usually harmless if the movement is done slowly (Bauer, 1984).

They do not cause ischaemic brain stem syndromes and are fully compensated by simultaneous increases of flow in the contralateral vertebral artery, as was proven by systematic doppler sonographic, examinations. Only very rarely a vertebral artery might be bent during head rotation and cause brain stem symptoms, but only if the opposite artery is not available as a collateral, if for example it is either extremely hypoplastic, or not fully developed, or has already been obstructed by a previous obstructing illnesses (Ringelstein, 1997).

Manipulations of the neck, in particular rotating manipulations, which go to the final positions, are dangerous. Even if complications are extremely rare (Rivett and Milburn, 1996; Haldemann, 1999), they might cause dissection of the vertebral artery and hence serious, life-threatening insults and permanent infarcts of the vertebrobasilar blood supply area (Parenti, et al., 1999; Machado, et al., 1999; Lee, et al. 1995; Frisoni and Anzola, 1991).

People with structural anomalies of the connective tissues (Kimura, et al., 1997) in particular with fibromuscular dysplasy, anomalous blood vessels (Bartels and Flugel, 1996), which might not be recognized in advance by the therapist, are especially endangered. This explains why especially younger people, even more so younger women with loose connective tissues, might suffer injuries by stretching the Lamina interna of the A.vertebralis in the height of the atlas caused by sudden rotating manipulations (Mass, et al., 1999; Ringelstein, 1997). Literature describes such injuries after minimum trauma during activities such as tennis, golf, yoga or volleyball (DeBehnke, 1994).

If patients complain about neck problems, these complaints might be caused by a concealed spontaneous dissection, which might be aggravated acutely by manipulative treatment (Ringelstein, 1997; Silbert, et al., 1995; Sturzenegger, 1994; Frumkin and Baloh, 1990; Robertson, 1981).

A major symptom of arterial dissection is an intensive unilateral headache in the region of the occiput. Frequently, additional cerebral ischaemic symptoms occur only in the later course of illness (Mass, et al., 1999). In more than one third of all cases, a Hornersyndrome occurs as the consequence of the irritation of the perivascular sympathic fibers (Sturzenegger and Steinke, 1996). In some cases, patients report painless proximal pareses in the arm within one week after the headache (Brahee, 2000; Hetzel, et al., 1996). In the progression of the illness, cerebellar syndromes, vestibular syndromes or the Wallenberg syndrome might also occur (Sturzenegger, 1994).

All authors report that one of the main causes of the rare Wallenberg syndrome is the dissection or the extracranial arteries. The Yamagata University in Japan reports in a base of 16 cases, that dissection is secured as definite cause in 7 cases, is the probable cause in 3 cases and is the possible cause in 3 cases (Hosoya, et al., 1994). Another study from the same university mentions it as the definite cause in 23 patients, as the very probable cause in 23 patients, and as the possible cause in 27 patients, all over a base of 93 patients (Hosoya, et al., 1996).

Taking into consideration the rare complications, which however often are lethal or very serious, the benefit and risk of manipulation seems worthy of discussion, even more so as post-manipulation, one can not differentiate whether the dissection had already existed pre-treatment, or has been caused by the treatment.

The differential diagnosis of craniocervical pains in young patients should include arterial dissection, as only early diagnosis and medical treatment may reduce the long-term neurological damage (Chang, et al., 1999). The only safe method of diagnosis are the magnetic resonance method, angiography, and color-coded duplex sonography (Karrasch and Ludwig, 1999; Chang, et al., 1999; Bartels and Flugel, 1996).

5.5 Suggestions for further research

The following theme complexes could be improved in further studies.

5.5.1 Population

In order to increase the reliability and reproducibility of the results, a larger sample population could be used. Then it would also be possible to examine men against women.

5.5.2 Single operator

A repetition of the current study performed by a different examiner and ideally involving two or three treating osteopaths would limit any single operator bias.

5.5.3 Comparative osteopathic techniques

This study has illustrated the effect of an upper cervical strain and counterstrain technique and it would be useful to conduct a similar study in order to compare the effects of other osteopathic techniques, such as muscle energy techniques or cranial base release techniques

5.5.4 Long-term effect

It would also be useful to consider whether upper cervical treatment has a long-term effect on WBA. Will the effect proven by this study after a period of two weeks survive in the long-term, or will it even increase?

5.5.5 A comparison of upper versus lower cervical spine

Studies could also be undertaken to investigate the effect of a lower cervical treatment with strain and counterstrain in comparison to an upper cervical treatment. This may be used to indicate possible differences in proprioceptive input from the lower and upper cervical spine.

6 CONCLUSION

This study proves that, with a high probability, both therapeutic procedures have an influence on the regulation of the weight bearing asymmetry. Though, at medium-term, the HVLA-thrust technique seems to be therapeutically more effective compared to the strain/counterstrain technique. But since the HVLA-thrust technique has a higher risk for the patient, it is necessary to assess the gain versus the danger in each individual case.

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APPENDIX 1

QUESTIONNAIRE

The difference on weight bearing asymmetry in the frontal plane by treating the upper cervical spine with HVLA- Thrust or Strain/Counterstrain

Please answer the following questions and fill out the according blanks. All given information is treated confidentially. If you are unsure about an answer, please ask.

Part 1

1. Name .... Geschl.: M ... F ...

2. Alter: .... Jahre Gewicht: .... kg Größe: ....m

3. Welches ist ihr dominantes Bein? Re. ...... Li. ......

Teil 2

4. Findet zur Zeit eine osteopathische oder manualtherapeutische Behandlung an Ihrer Wirbelsäule oder Extremitäten statt? Ja .... Nein ....

Wenn ja, beschreiben Sie bitte was, und an welchen Körperteilen es vorgenommen wird.

..

..

..

5. Leiden Sie zur Zeit unter Nackenschmerzen? Ja .... Nein ....

Wenn ja, beschreiben Sie bitte den Schmerz und seine Dauer.

...

...

..

6. Hatten Sie früher Nackenschmerzen? Ja .... Nein ....

Wenn ja, beschreiben Sie bitte den Schmerz und die Dauer.

...

...

..

7. Hatten Sie in der Vergangenheit, oder leiden Sie zur Zeit unter

Schwindel?

Bewußtlosigkeit?

ständigen oder wiederkehrenden Kopfschmerzen?

Sehstörungen?

Kraftverlust an den oberen oder unteren Gliedmassen?

Sensibilitätsverlust an den oberen oder unteren Gliedmassen?

Wenn ja, teilen Sie uns die Details bitte mit:

...

...

..

8. Leiden Sie an zu hohem oder niedrigem Blutdruck? Ja .... Nein ....

Wenn ja, geben Sie bitte die Details an:

...

...

9. Hatten Sie Früher oder zur Zeit entzündliche Gelenk Beschwerden?

Ja .... Nein ....

Wenn ja, bitte die Details angeben:

...

...

Teil 3

10. Hatten Sie Operationen an den unteren Extremitäten (Beine/Füße)?

Ja .... Nein ....

Wenn ja, bitte Details angeben:

...

...

11. Hatten Sie in der Vergangenheit, oder haben Sie zur Zeit, Verletzungen an der Lendenwirbelsäule / dem Kreuzbein?

den Hüften?

den Knien?

den Knöcheln?

Wenn ja, bitte Details angeben:

...

..

Teil 4

12. Hatten Sie in den letzten 3 Wochen irgendwelche Krankheiten?

Ja ....   Nein ....

Wenn ja, bitte Details angeben:

...

..

13. Hatten Sie in der Vergangenheit oder zur Zeit ernsthafte Erkrankungen?

Ja ....   Nein ....

Wenn ja, bitte Details angeben:

...

..

Vielen Dank für Ihre Zeit und ihre Bereitschaft, diesen Fragebogen auszufüllen.

....(Unterschrift)

................................(Datum)

APPENDIX 2

<u>EINWILLIGUNGSERKLÄRUNG</u>

Ich habe den „Fragebogen“ freiwillig ausgefüllt, und die von mir gegebenen Antworten sind so weit es mir bekannt ist korrekt.

Meine Teilnahme in diese Studie ist freiwillig, und ich kann jeder Zeit aus der Studie aussteigen.

Hier mit erkläre ich meine Bereitschaft an dem Experiment teil zu nehmen.

Name (Druckbuchstaben) :..

Unterschrift: ....

Datum: ....